UNCERTAINTY MANAGEMENT IN REAL ESTATE DEVELOPMENT: STUDYING THE POTENTIAL OF THE SCRUM DESIGN METHODOLOGY

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Abstract
Real estate development is all about assessing and controlling risks and uncertainties. Risk management implies making decisions based on quantified risks to execute risk-response measures. Uncertainties, on the other hand, cannot be quantified and are therefore unpredictable. In literature, much attention is paid to risk management. The management of uncertainties is underexposed. Uncertainties appear in the programming and designing phases of projects. The main goal of our research is to develop guidelines for real estate developers to manage uncertainties in those phases.

We believe that new process approaches, e.g. the Agile Design Methodology SCRUM, are promising tools to achieve this goal. SCRUM is an incremental, iterative design methodology which is characterized by 30-day, isolated sprints where chaos is let in, alternated with controlled evaluation moments in-between the sprints. It replaces the traditional program-, design- and realization-phases. The SCRUM methodology originates in the development of consumer-based software products. Our research is aimed at determining the possibilities and limitations of the application of SCRUM in real estate development and to study its effects on uncertainty management.

The research is conducted using a literature study on traditional risk management, uncertainty management and process management in real estate, case studies and confrontations between those. We conclude that SCRUM has potential to manage uncertainty in real estate development if parts of it are combined with aspects of traditional process approaches. We developed a first combined approach, called RESCRUM, which offers a more flexible process with better uncertainty management, eventually leading to more certainties in projects and a better basis for risk management. Further research should focus on refining the combination of SCRUM and the traditional process and testing this combination in practice. Therefore, a more extensive study on social processes in real estate development should be performed as well.

Keywords: Design process, Process approach, Real Estate Development, SCRUM Methodology, Uncertainty Management.

INTRODUCTION

In order to achieve a good investment with expected returns, real estate projects need to be managed properly. This management mainly focuses on assessing and controlling risks and uncertainties. Risk management is making decisions based on

quantified risks to execute risk-response measures, and is thus a basis for decision making in a project (Miles, 1997). Risks are defined as predictable, calculable events that have a negative effect on the returns of a project (Gehner, 2003). Risk management therefore focuses on analyzing risks, implementation of control measurements and evaluation of those.

Managing uncertainties is underexposed in the literature. Literature on risk management mainly focuses on the second part of the development process, where a definitive design is made and the object is realised. In this part of the process, certainties are present to inventory risks and make calculations on them. However, the most important decisions are made in the first part of a project, where the process is hard to control due to the involvement of many, strategically acting actors and the lack of certainties. This results in uncertainties in the programming and (preliminary) design phases, failing to form a basis for risk management.

The main goal of our research is to develop guidelines for real estate developers to manage uncertainties in their projects. We believe that new process approaches, like the Agile Design Methodology SCRUM, are promising tools to achieve this goal. The construction industry might be able to learn from this process approach that originates in the development of consumer-based software products. The derived goal in our research is therefore to determine the possibilities and limitations of the application of SCRUM in real estate development and to study its effects on uncertainty management in the early phases of a project, such as the programming and design phases.

The research is conducted by developing a theoretical framework, based on a literature study on traditional risk management, uncertainty management and process management in real estate development, case studies in real estate development projects and confrontations between those. We confronted the results of the literature study with a first case study to get insight in the current application of uncertainty and process management in real estate development processes. Then, we confronted the traditional process approaches with the SCRUM methodology in order to derive differences and similarities related to uncertainty management. Next, we simulated the application of an adjusted SCRUM process (named RESCRUM) in the upcoming design activities of a second case study to study the possible application of (RE)SCRUM in real estate development in practice.

The paper starts with describing main characteristics of uncertainty management in real estate development, based on a literature study and the first case study. This overview is followed by a comparison of the SCRUM process approach with traditional process approaches. Finally, the combined process approach RESCRUM is presented and applied on the second case study.

UNCERTAINY MANAGEMENT IN REAL ESTATE DEVELOPMENT

Management of uncertainty

To define proper manners for uncertainty management, sources of uncertainty have to be identified. In different studies complexity, and especially social complexity, is

mentioned as the main source of uncertainties (Granath, 1991, Degrace, 1991, Drogendijk, 1997, Bertelsen, 2003). This complexity originates in the involvement of multiple, strategically operating actors in real estate development projects. Management of complexity is thus an important part of management of uncertainties.

The management of uncertainties can be set up from two approaches (Lerdahl, 2001). The first approach derives certainties by defining decision moments and documents beforehand. Requirements, (preliminary) designs and detailed construction plans offer developers certainties to build on during the rest of the process. These decision moments and documents do not cope with complexity and changes during the project and are imposed by one actor.

The second approach focuses on a more pragmatic way to manage uncertainties by managing social complexity and reacting on the current project environment. Social complexity is best managed by adjusting goals and means of individual actors (Teisman, 1992, Conklin, 2003), focussing on the problem definition and creating commitment for the project by different actors involved (Lerdahl, 2000, Koskela, 2001). Next to that, the involvement of the market (the clients and users of projects) in the process ensures better management of uncertainty as well. By managing complexity, flexibility is achieved as well. Changes by actors or environment demand a flexible process. If goals and means of both active actors and the market are taken into account explicitly, changes are more predictable and due to high commitment, changes can be implemented as well.

In Appendix 1, a table is displayed to show the main factors that contribute to the management of uncertainty, forming the basis of the theoretical framework. The factors are divided in Phasing, Flexibility, Cooperation, Controlability and Predictability (Miles, 1997, Drogendijk, 1997, Gehner, 2003, Roozenburg, 1995).

Management of uncertainty in the traditional process

The traditional real estate development process is set up as outlined in Figure 1 (Miles, 1997, Gehner, 2003). A strict phasing is used with a decision point at the end of each (sub) phase. Often only the main actors related to the activity of a phase are involved. The traditional phasing does not imply other rules for cooperation.

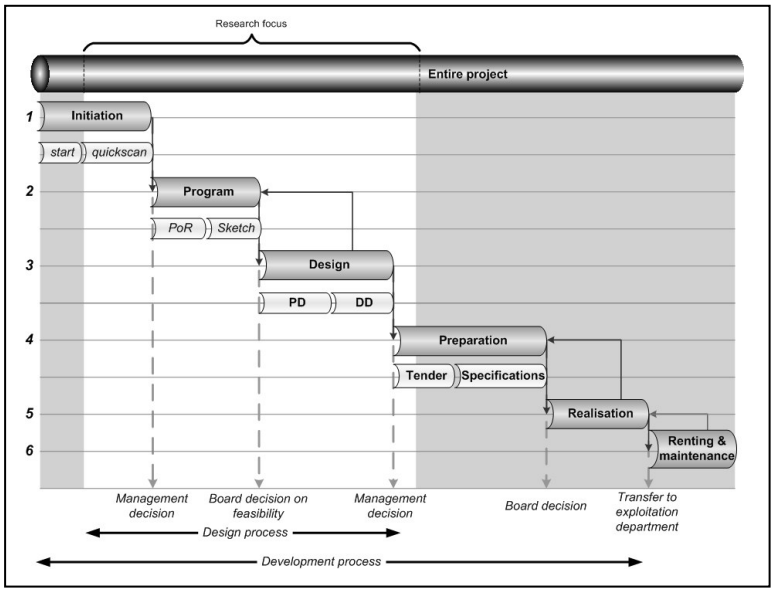

Figure 1 – Different phases of a (traditional) real estate development project

Looking at the management of uncertainty, only the proactive part of setting certainties by decision documents is implemented. Though there is no explicit attention for management of complexity, the traditional process offers room for further fill-in by additional methodologies. The traditional process defines thus certainties by setting decision points in the process, but the management of complexity is underexposed. Characteristics of uncertainty management in traditional processes are summarised in Appendix 1.

Practical application of uncertainty management

To test the obtained insights in current practice, a case study has been conducted. The 'Witte Keizer' project in Rotterdam is the realization of a living-/ office-tower in the center of the city. It contains 108 luxurious apartments, 2700 sq m office space and 145 parking places in a full automatic underground parking garage. In Figure 2 the project can be seen during construction phase.

Figure 2 - The 'Witte Keizer' project under construction, Rotterdam 2004 (www.skyscraper.com forum)

In the case study, the set up of the (design) process and the current management of uncertainties in practice were examined and compared with the theoretical framework. It turned out that the traditional process approach, as defined earlier, is used explicitly in the project. Next to that, more actions were taken to manage the project. Examples of those are the involvement of an architect in the program phase, the intense meeting schedule, the involvement of a project coordinator of the municipality and a strong project manager.

Looking at the management of uncertainties, in accordance with the application of the traditional process, especially the definitions of certainties are applied. More implicitly, the additional management actions in the project have led to a fairly good management of complexity. All together, uncertainties are management well, but with implicit and therefore opportune measurements.

A NEW PROCESS APPROACH: SCRUM

In the development of commercial, consumer-based software products, a new methodology SCRUM is derived from practical process optimisations (Schwaber,

2002). New approaches of process management like AGILE and LEAN management are found to be a basis for SCRUM. *AGILE management* focuses on the effectiveness, i.e. the value of the product for the client. Value management is an important part of AGILE management. It sets up the design process in a pragmatic way with team-based, bottom-up design processes. The evaluation of (preliminary) designs is important in the method (Koskela, 2001, Yan, 1999). *LEAN management* focuses on efficiency, i.e. optimizing the process. Planning techniques and flexibility are important parts of LEAN management, which come forward in Flow- and Task management (Koskela, 1997, Poppendieck, 2003). Knowledge management also forms an important basis for process approaches (Nonaka, 1997). With proper knowledge management more creativity and knowledge creation of teams can be achieved, which adds to LEAN and AGILE management.

SCRUM proposes a pragmatic, single phase design process in which multifunctional teams design prototypes in 30-day sprints. These sprints are completely cut-off from external influences. After each sprint, evaluations of the process and the prototype of the product are conducted in scrums. In these scrums, influences and changes are inventoried and put on a backlog. From this list of priorities, which is managed by the SCRUM-master, new sprint-logs are abstracted to start new sprints (Schwaber, 2002). In Figure 3 the SCRUM process is displayed underneath a, simplified, traditional design process.

Important in the SCRUM process is the lack of phase boundaries. The team members with different backgrounds do all activities in a sprint that traditionally are done in separate phases. At the start of the first sprint, there is thus no product definition or additional boundaries. In sprints, teams are given complete freedom to program, design and realise according to their sprint-log (chaos). After that, in scrums the product is evaluated and adjusted (order). Characteristics of uncertainty management in SCRUM processes are summarised in the table in Appendix 1.

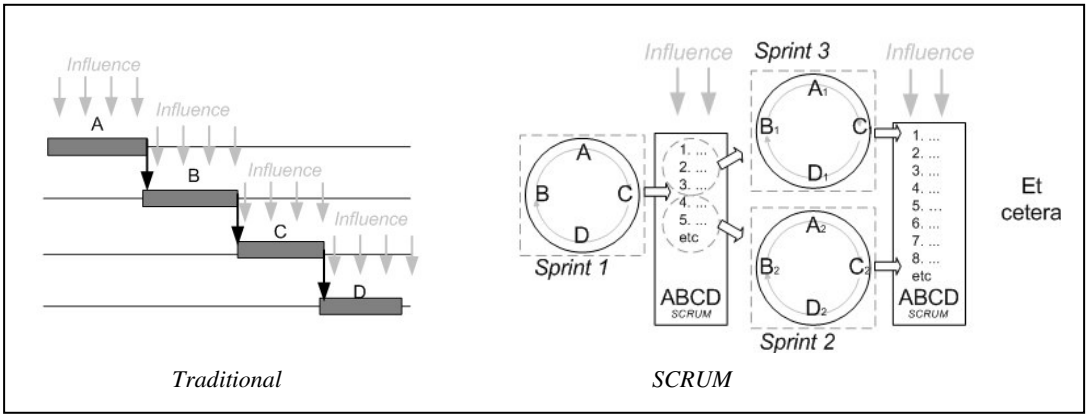

Figure 3 - A traditional and a SCRUM process with main actors A, B, C and D

The close cooperation between team members with different backgrounds is one of the main bases for the success of the methodology (Schwaber, 2002, Lerdahl, 2001, Degrace, 1991). Due to the great intensity, the freedom in a sprint and the cut-off environment, SCRUM creates commitment for a project and, together with a planning tool closely related to LEAN management, an efficient process. The evaluations in scrums and the possibility to involve potential customers, gives a practical application of AGILE management.

Looking at the management of uncertainty, SCRUM focuses on reactive and pragmatic management of social complexity. The tuning of goals and means, the creation of commitment and the flexible process, due to the lack of overall structure and planning, indicates a potential good process to manage uncertainties.

To eventually apply SCRUM in real estate development, it must be compared with the traditional process and the properties of real estate development. The most important difference that comes up is the difference in focus of managing uncertainties. The traditional process focuses on the definition of certainties by using a phasing with decision documents, defined before the project starts. SCRUM focuses on pragmatic and reactive management of complexity. This is a fundamental difference. With a lack of a decision point such as a Program of Requirements (PoR) in SCRUM, the application in real estate development means more uncertainties than in the current process. The main reason for the difference in these approaches is the background of the processes. SCRUM originates in the software development, where the design process is for a large part internal. A traditional real estate development process focuses on an external environment due to the involved actors in real estate development.

(RE)SCRUM IN REAL ESTATE DEVELOPMENT

In order to use the potential advantages of SCRUM in real estate development, adjustments to the methodology have to be made. From the comparison with the theoretical framework it turns out that most of all the planning in phases is withholding SCRUM from application in real estate development. The addition of uncertainties by leaving the process completely open is not suited for real estate development.

By taking advantage of the main advantages of both the traditional process (phasing and decision points) and the SCRUM process (managing complexity) the SCRUM process is inserted in the traditional phasing. This new process is called RESCRUM (Real Estate SCRUM) and is displayed in Figure 4. In Appendix 1, the properties of the RESCRUM process can be compared with those of the traditional and the SCRUM process.

RESCRUM

By using the traditional phasing, decision points at the end of a phase focus on one main activity per phase and the external, fragmented processes remain. By using the sprints and scrums of SCRUM, RESCRUM offers a useful manner to introduce the new process approaches aimed at managing uncertainties in real estate development.

For using RESCRUM properly, all parts of SCRUM need to be filled in properly. In sprints, all actors from the project need to be involved. That means that construction firms and architects are part of sprints in the programming phase as well. This is the only way to take advantage of the potentials of SCRUM. In sprints, the intensity, explicit tuning of goals and means, cut-off process from influence and changes and the clear goal of developing a prototype generate commitment, flexibility and effectiveness of the process.

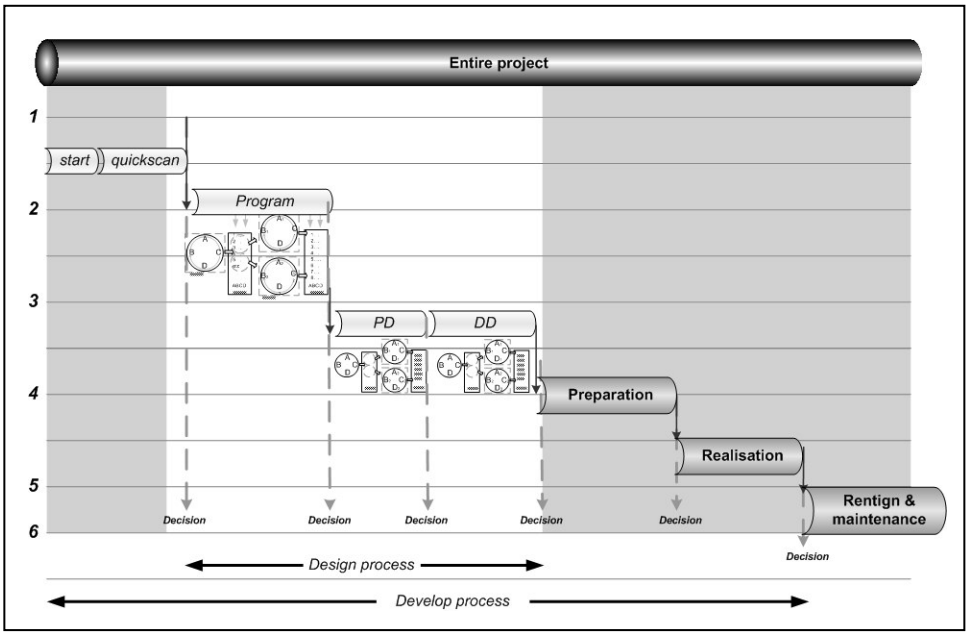

Figure 4 – Phasing in a RESCRUM process

In this way, complexity can be managed according to SCRUM and certainties can be defined according to the traditional process. Still, application of RESCRUM in real estate development could not be achieved by simply using sprints and scrums. Different roles of SCRUM, such as the SCRUM master are needed. Next, a mandate is needed from involved organisations to give sprints all the developing space they need, criteria are needed to determine the progress of a sprint and prototype and to evaluate a prototype each scrum, et cetera. But most of all a shift of focus is needed to give more attention to the early phases of a project and create common project goals. By using RESCRUM from the early program phase, the effectiveness and efficiency of the process can be greatly improved. If RESCRUM is only used in the design phase, already much complexity and restrictions to the process will be present.

Practical application of RESCRUM

A second case study is conducted to test the practical application of RESCRUM. The development of a multi-use tower on the Gershwin area at the 'Zuidas' in the southern part of Amsterdam was chosen for the test. The project had a long history of studying the potentials and tuning the PoR. After the start of the Preliminary Design (PD) phase, the process was stopped due to changes in the environment of the project and the difficulties of adjusting the design to the needs. A new PoR was made and during the period of our research, a new PD phase was started. In a workshop with involved actors and a verifying interview with a second developer, the possibilities for the use of RESCRUM in practice were discussed.

Though the results were only a first indication of the practical value of the methodology, it showed that RESCRUM has potentials. The common reaction was that the focus on soft factors in managing complexity in early phases was very useful. By creating a common project view in that phase, a successful project will mean success for all participating actors. The freedom in sprints, evaluation in scrum and the explicit intensity, tuning of means and goals and involvement of all actors were found to be of great value for the project.

Practical difficulties were indicated as well. Especially the intensity and continuous cooperation of actors was found to be very difficult in current practice. Next, the cooperation with the municipality was indicated as very hard. In practice, the municipality would not be willing to participate in sprints. Possibilities to ask the municipality at the evaluation process in scrum were suggested. In that way, the prototype would still gain value and goals and means of the municipality can still be taken into account. Finally, the shift of focus to early phases was found to be hard in current practice, but possible in the future.

CONCLUSIONS AND RECOMMENDATIONS

The main target of the research was to determine the possibilities and limitations of the SCRUM methodology for managing uncertainties in real estate development projects. The traditional process in real estate development only copes with defining certainties and does not cope with the management of complexity in a project. Thereby, it makes the management of uncertainties opportune. SCRUM offers a manner to introduce new approaches for process management, but does not cope with differences between the construction industry and the software industry, where it initiates. RESCRUM combines the most valuable parts of both and can actually contribute to the improvement of the management of uncertainties in real estate development. It could contribute to a better risk management and hereby to a better ground for making decisions for the returns and successes of a project.

The main possibilities of RESCRUM are:

- Alternation of chaos and order in sprints and scrums, as a result of what goals and means can be tuned explicitly, knowledge can be created and prototypes can be developed flexible;
- An intensive process as a result of what priorities rest with the project and commitment stays high;
- Focus on the program phase as a result of what a PoR really offers certainty to the project organisation and the developer.

The main shortcomings of the use of RESCRUM are:

- The involvement of municipalities in sprints is hard;
- The assessment of the status of a sprint or prototype is hardly measurable;
- The needed open communication and focus on the program phase demands a cultural change and trust of actors in real estate development;
- The intensity of the process demands a focus on fewer projects on a personal level.

Further research should concentrate on cooperation between actors. Main topics are realising open communication, knowledge management and implementing a shift of costs to earlier phases of a project and determining measurable effects of that shift. Furthermore, the role of municipalities in the RESCRUM process, both from the project organisation's as from the municipality's point of view and the representation of the market in the RESCRUM process should be studied.

We would like to conclude with some managerial implications. The process organisation with RESCRUM demands for a new way of cooperation and a deep involvement of all main actors. Thus, a cultural change is needed in real estate

development. With the centralised position of the developer in the process, he is the right actor to initiate this change. He has to address the following topics:

- Application and optimisation of (parts of) RESCRUM in regular projects, initially in single phases;
- Developing an internal decision model to ensure internal certainties and a good basis for external decisions;
- Developing a focus on early phases in a project within the entire organisation;
- Exploration for the proper cooperation model for the RESCRUM process.

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REFERENCES

Conklin, J. (2003) *Dialogue Mapping: Defragmenting Projects through Shared Understanding,* CogNexus Institute

Degrace, P., Stahl, L.H. (1991) *Wicked problems, righteous solutions,* Yourdon press, Engelwood Cliffs, New Jersey, USA

Drogendijk, A. (1997) *Complexiteit bij ruimtelijke investeringsprojecten,* University of Amsterdam, Amsterdam, Netherlands

Gehner, E. (2003) *Risicoanalyse bij projectontwikkeling,* SUN, Amsterdam, Netherlands

Granath, J. Å. (1991) *Architecture, Technology and Human Factors; design in a Socio-Technical context,* Chalmers University of Technology, Göteborg, Sweden

Koskela, L., Ballard, G., Tanhuanpää, V. (1997).*Towards Lean Design Management,* VTT Building Technology, Espoo, Finland

Koskela, L., Huovila, P., Leinonen, J. (2001) *Journal of Construction Research,* 3-1, 1-16.

Lerdahl, E. (2000) *Proceedings of NordDesign 2000,* August 24-25, 245-254.

Lerdahl, E. (2001) *Staging for creative collaboration in design teams,* Norwegian University of Science and Technology, Department of product design Engineering, Trondheim, Norway

Miles, M. E., Haney, R.L., Berens, G. (1997) *Real Estate Development,* Urban Land Institute, Washington, D.C., USA.

Nonaka, I., Takeuchi, H. (1997) *De kenniscreërende onderneming,* Scriptum, Schiedam, Netherlands

Poppendieck, M. (2003) *Tutorial on Lean Design Management,* Poppendieck LLC, Eden Prairie, Minnesota, USA.

Roozenburg, N. F. M., Eekels, J. (1995) *Product design: Fundamentals and methods,* John Wiley & Sons Ltd., West Sussex, England.

Schwaber, K., Beedle, M. (2002) *Agile Software development with SCRUM,* Prentice Hall, Upper Saddle River, New Jersey, USA.

Teisman, G. R. (1992) *Complexe besluitvorming,* Erasmus University Rotterdam, Rotterdam, Netherlands
Yan, H. S., Jiang, J. (1999) *Integrated Manufacturing Systems,* 10/2, 103-112.

APPENDIX 1 – PROPERTIES OF DIFFERENT PROCESSES

Topic	Traditional	SCRUM	RESCRUM
Phasing with decision documents	Initiation, Program, PD, DD	Initiation, overall. Prototypes as semi decision documents.	Same as traditional. Both prototypes and traditional decision documents
Planning	Linear and phase-exceeding, dictated by developer	Alternation of sprints and scrums; planning on details only for next sprints; responsibility at sprint team	Same as SCRUM only main structure dictated by developer
Dictating nature of methodology	Main structure; open for additional filling-in, even at high levels of abstraction	Strongly dictating, only room for additional filling-in at low levels of abstraction. Completely open in sprints.	Same as SCRUM
Focus	Mainly on designing. In early phases only developer involved	Both on programming as on designing due to early involvement of all actors	Same as SCRUM with additional focus on programming due to PoR
Flexibility	Product: Dependent on initiatives of developer. Process: Limited; fixed and linear structure, limited input of desired changes, limited possibilities for implementation	Product: Better possible due to close cooperation. Process: Large; structural check of prototype with desired changes, sprint useful for implementing changes	Product: Same as SCRUM. Process: Same as SCRUM, but limited due to decision documents in structure
Communication	Normative, risks for strategic behaviour	Active and open due to sprints and intensity	Same as SCRUM, but normative and in phase-transitions
Intensity	Dependent on project leader and other actors	High due to successive sprints	Same as SCRUM
Adding info / Adjust priorities	Continuously during design process	Only during scrums	Same as SCRUM with additional moment in-between phases
Tuning of goals and means	Low; only broad framework and dictated goals of developer	Good due to simultaneous programming and designing	Good; both due to simultaneous process and different phases
Formal controllability (in search of certainties)	Fair; decision documents on phase transitions	Low; only soft decisions on prototypes	Besides tuning on prototypes formal decision documents on phase transitions
Informal controllability	Low due to lack of good communication and commitment	High due to high intensity, open communication and tuning in sprints	Same as SCRUM
Predictability	Fair; due to PoR certainty with respect to the content. Changes not predictable	Fair; due to lack of PoR no certainty on content, but high tuning in sprints and scrums to predict and react on changes	Good; both certainties in (e.g.) PoR (content) as in upcoming changes and desired implementation of those